Characterising diurnal- and synoptic-timescale changes in urban air quality using Radon-222

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Urban air quality is strongly influenced by the atmosphere's ability to disperse primary emissions and opportunities for secondary pollution formation. In mid- to high-latitude regions that experience enduring winter snow cover or soil freezing, regional subsidence and stagnation associated with persistent anti-cyclonic conditions such as the "Siberian High" can lead to "cold pool" or "persistent inversion" events. These events can result in life-threatening pollution episodes that last for weeks. While often associated with complex topography [1,2], persistent inversion events can also influence the air quality of urban centres in flat, inland regions [3]. This presentation will describe a recently-developed radon-based technique for identifying and characterising synoptic-timescale persistent inversion events, which is proving to be a simple and economical alternative to contemporary meteorological approaches that require regular sonde profiles [1]. Furthermore, key assumptions of the radon-based technique to characterise diurnal-timescale changes in the atmospheric mixing state described by Chambers et al. [4] are violated during persistent inversion conditions. Here we demonstrate how atmospheric class-typing, through successive application of radon-based techniques for identifying synoptic- and diurnal-timescale changes in the atmospheric mixing state, improves understanding of atmospheric controls on urban air quality in non-summer months across the full diurnal cycle. This knowledge translates directly to statistically-robust techniques for assessing public exposure to pollution, and for evaluating the efficacy of pollution mitigation measures. Lastly, we show how atmospheric class-typing can be used to enhance the evaluation of chemical transport models [5].

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